Cruise report
Irish Anglerfish & Megrim Survey 2018

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Cláir Chistí Eorpacha Struchtúrtha agus Infheistíochta na hÉireann 2014–2020
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Contents

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Introduction

The 2018 Irish Anglerfish and Megrim Survey (IAMS) took place from 20th February to 19th March (area 7bcjk) and 10-21st April 2018 (area 6a) on RV *Celtic Explorer*.

The main objective of the survey is to obtain biomass estimates for anglerfish (*Lophius piscatorius* and *L. budegassa*) and establish an abundance index for megrim (*Lepidorhombus whiffiagonis* and *L. boscii*) in areas 6a (south of 58°N) and 7 (west of 8°W).

Secondary objectives are to collect data on the distribution and relative abundance of anglerfish, megrim and other commercially exploited species. The survey also collects maturity and other biological information for commercial fish species.

The IAMS survey is coordinated with the Scottish Anglerfish and Megrim Survey (SIAMISS) and uses the same gear and fishing practices.

Methods

Stratification

The stratification is based on the following considerations:

- Depth: 0-200m; 200-500m and 500-1000m.
- Clearly defined fishing grounds (from VMS-logbook data: Gerritsen and Lordan, 2011; Gerritsen *et al*., 2012) were identified as separate strata; an area with high fishing intensity surrounded by low fishing intensity signify that the bottom type and ecology on the fishing ground is different from that of the surrounding area. Examples include the Porcupine, Aran and Labadie *Nephrops* grounds, the Stanton Banks and Stags grounds.
- Catch rates of the target species (anglerfish and megrim) from VMS-logbook data as well as IBTS and previous Anglerfish & Megrim surveys were also taken into account in determining the boundaries of the strata.
- Rocky bottom types are excluded from the survey area which implies an assumption that the densities of the target species are zero in those areas.
- Regions 6a and 7 are treated separately because they comprise different assessment and TAC areas.

The density of sampling stations in each stratum was either low, medium (twice the low density) or high (four times the low density). These station densities were assigned to each stratum so that the number of stations in each stratum would be roughly proportional to the expected standard deviation of the biomass estimate in the stratum.

Three small strata with expected low abundance of the target species (Aran and Porcupine *Nephrops* grounds and the area of coarse sediment on the Porcupine Bank) were combined into a single stratum (VII_Shelf_L) despite the differences in depth and bottom type.

The strata are shown in Figure 1 and summary statistics are provided in Table 1. The naming of the strata reflects the region (VIa or VII), area (continental shelf or slope) and density of stations (Low, Medium, High).

Station selection

Sampling stations were selected at random in the following way:

1. Add a 30nm buffer around the survey area (to avoid edge effects)
2. Select 10,000 random points within the (buffered) survey area
3. Identify the pair of points that are closest to each other (nearest neighbour)

4. Remove the point of this pair that is closest to its second-nearest neighbour
5. Repeat steps 3. and 4. until only one point remains
6. Rank the stations in each stratum based on the order in which they were removed – giving stations removed last the highest priority – this ensures that regardless of how many stations are selected in a stratum, they will always be distributed approximately evenly (but randomly) in space

The target number of stations is 45 in area 6a and 70 in area 7bcjk. This means that stations with priority number 1-45 and 1-70 respectively will be selected to be trawled. In practice some of the high priority stations may have been dropped (in cases where it was impossible to achieve a valid tow) and replaced by the 'spare' stations with priority numbers >45 and >70 respectively.

A tow track was picked to go through the randomly selected points. Where it was impossible to do so (owing to underwater cables, passive gear, unsuitable bottom and the like) it was attempted to find a tow track that came within 1nm of the selected point.

Four to six weeks prior to the departure a Marine Notice was issued (www.dttas.ie) to advise seafarers and fishermen about the proposed work. This document included a brief description of the survey methods and objectives including a list and map location of the proposed stations.

Fishing operations

The trawl is based on a standard commercial otter trawl used in the anglerfish fishery and is described in detail in Reid *et al*. (2007). The mesh size varies from 200mm in the wings gradually reducing to 100mm in the cod-end. The ground gear is fitted with 16'' rock hopper disks and a 19mm tickler chain is mounted between the wings, rigged to run ahead of the ground gear. The trawl doors were 5.45m^2 Thyboron Type 16 straight oval doors (adapted from the 5.25m^2 doors used in 2016)

The gear was trawled at 3kn for one hour at each station. The warp to depth ratio was 3/1 for depths up to 200m, and 2/1 plus 200m in deeper water.

Door spread, wing spread, headline height and bottom contact were monitored using Scanmar and Marport trawl sensors (distance sensors in the doors and wing-ends, headline sensor and a trawl-eye sensor positioned on the top sheet directly over the footrope).

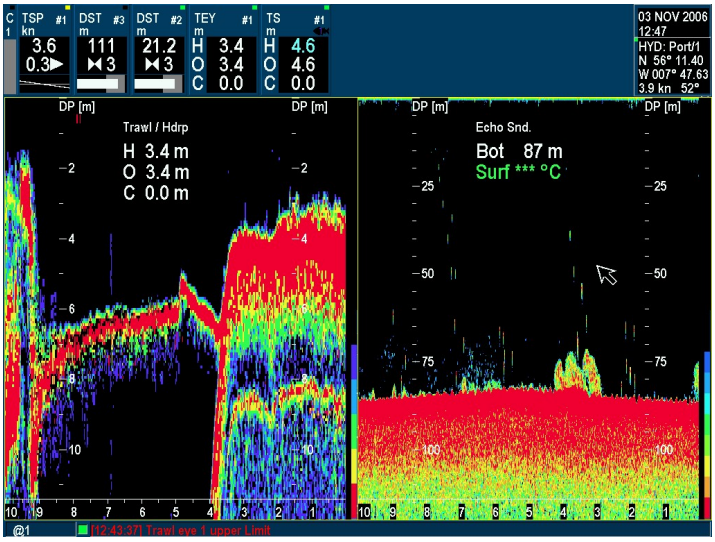

Figure X: Scanmar display showing trawl geometry, water depth and fishmarks.

Wet lab protocol

All fish and invertebrate species were sorted and weighed. Biological data were collected for the species listed in the table below. Occurrence of the following vulnerable or sentinel invertebrate species was noted if present: corals, sea pen, fan mussel and ocean quahog.

Priority	Task
1	If you are under extreme pressure only sort and sample anglerfish and megrim For anglerfish, record the gutted weight in the 'serial number' box ; collect otoliths as well as illica.
2	Sort and weigh all fish and squid species, *Nephrops* and litter. Record the total weight of benthos as a comment. Sort benthos only for indicator species (see table above) record weights. Take picture or preserve sample if unsure about ID and record as comment
3	Take biological samples for the demersal listed in the table below.

Note: If you can't complete all the work, drop tasks in reverse order as listed above. Never record sample weights for a few species; record all or just anglerfish and megrim). On invalid hauls you can still collect biological data.

	Species	Sort by sex	OTO box	Catch weight	Can you subsample	Bio target	Live weight	Sex	Mat	Age	Gutted weight
Aged demersal species	COD	U	100-149	yes	yes	1pcm	yes	yes	yes	yes	**yes**
	HAD	U	150-249	yes	yes	100%	yes	yes	yes	yes	no
	LIN	U	250-299	yes	yes	1pcm	yes	yes	yes	yes	no
	MEG	F/M	300-364 / 365-399	yes	yes	1pcm	yes	yes	yes	yes	no
	MON*	U	400-499	yes	**never**	100%	yes	yes	yes	yes	**Yes**
	WAF*	U	500-599	yes	**never**	100%	yes	yes	yes	yes	**Yes**
	PLE	F/M	600-649 / 650-699	yes	yes	1pcm	yes	yes	yes	yes	no
	POK	U	700-749	yes	yes	1pcm	yes	yes	yes	yes	no
	POL	U	750-799	yes	yes	1pcm	yes	yes	yes	yes	no
	SOL	F/M	800-849 / 850-899	yes	yes	1pcm	yes	yes	yes	yes	no
	WHG	U	900-989	yes	yes	100%	yes	yes	yes	yes	no
Biological teleo	BLL	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
	HKE	U	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
	JOD	U	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
	LBI	F/M	990-999	yes	yes	1pcm	yes	yes	yes	no	no
	LEM	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
	TUR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
	WIT	F/M	wkstn	yes	yes	1pcm	yes	yes	yes	no	no
Bio elasmo	BLR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	CUR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	DGS	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	DFL	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	DII	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	SDR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
	THR	F/M	wkstn	yes	yes	1pcm	yes	yes	yes**	no	no
Others	NEP	U	-	yes	nemesys	nemesys	nemesys	nemesys		no	no
	Most other demersal fish species***			yes	Yes	Measured-only					
	All pelagic fish species, squid; common demersals ***			yes	No length or biological samples						
	Invertebrates: Corals, sea fans, sea pens, fan mussels, Arctica islandica			Count & weight. If unsure about ID, take pic or freeze with haul label. For coral and A. islandica include comment on whether dead or alive							
	Other invertebrates			Total weight in comment field							
	Litter			As IGFS							
	CTD			As IGFS							

Key

Sex	F/M: record catch weight by sex (flatfish and elasmobranchs); U: do not sort by sex.
wkstn	use workstaton number when prompted for otolith box
subsample	these species can be subsampled for length and biological data, if necessary
1pcm	biological sampling target of one fish per cm size class (otolith target 1)
100%	biological sampling target set per length group, i.e. targets vary by size class (otolith target 100%)
*	• Monk <20cm that are not clearly black should be id'd using dorsal fin ray counts: WAF 9-10; MON 11-12 • Cut illicia to around 1cm so they fit flat in the otolith box and clean them so they don't stick to the tissue • When taking gutted weight, also remove the liver
**	Only determine the maturity of female elasmobranchs if they are already dead, otherwise record as stage 9.
***	Do measure: • All deep water species • Large gadoids like ling, blue link, tusk • All elasmobranchs except LSD • Any demersal species that is not very common Don't measure: • Any pelagics (including boarfish, blue-mouth, argentines) • Squid, octopus etc. • LSD (no need to record weight by sex either) • Any flatfish not listed in the biological sampling table above • Common demersal species of no or limited commercial value like gurnards, pout, poor cod, dragonets

Data collection and storage

Station positions, heading and bottom depth were recorded at the moment the gear settled on the bottom and when the gear was hauled back. Tide and wind direction and speed, barometric pressure, heave, pitch and roll were recorded at the mid-point in the tow. The median values of the door spread, wing spread and headline height were recorded at the end of the tow. The CEFAS software FSS (Fishing Survey System) was used to enter station data and import catch data. These data are stored in a SQL database (FSS_SURVEY) on a local server.

The gear sensor data as well as bottom depth and GPS position were also recorded in a SQL database (FSS_NMEA) at intervals of approximately one per second.

Catch weights, length frequency distributions and biological data were captured using the CEFAS Electronic Data Capture (EDC) system and stored into local Access '97 databases before being imported into the central SQL database (FSS_SURVEY).

Estimation

Catchability corrections for the two anglerfish species were applied following the methods described by the ICES working group WKAGME (2009). The equations were re-written to express the estimates in terms of capture probabilities (see also Yuan, 2012).

Footrope selectivity at length l, ($\hat{e}_{1l}$) was estimated using a 3-parameter logistic model:

$$\hat{e}_{1l} = \frac{1}{1 + \exp(-\beta_0 - \beta_1(l - \beta_2))}$$

$\beta_0 = 0.82257$, $\beta_1 = 0.11386$ and $\beta_2 = 35.5$

A herding coefficient ($\hat{h} = 0.017$) was applied to estimate herding in the area between the doors and wings (sweeps). The herding selectivity ($\hat{e}_{2li}$) was estimated as follows:

$$\hat{e}_{2li} = \frac{v_{1i} + \hat{h}v_{2i}}{v_{1i} + v_{2i}}$$

v_{1i} is the area swept by the footrope on tow i.
v_{2i} is the area covered by the sweeps on tow i.

The capture probability for a fish at length l in tow i in stratum s, (p_{lis}) is then given as:

$$p_{lis} = \hat{e}_{1l}\,\hat{e}_{2li}\,\frac{(v_{1i} + v_{2i})\,I_s}{A_s}$$

I_s is the number of hauls in stratum s.
A_s is the surface area of stratum s.

For megrim, no catchability correction is applied, so the capture probability is simply:

$$p_{is} = \frac{v_i\,I_s}{A_s}$$

The estimated number of fish ($\widehat{N}$) or biomass (B) in the survey area are then:

$$\widehat{N} = \sum_{i \in I} \frac{n_i}{p_{lis}} \qquad \hat{B} = \sum_{i \in I} \frac{n_i w_i}{p_{lis}}$$

n_l is the catch numbers-at-length in tow i
w_l is the mean weight-at-length, obtained from the length-weight relationship for the whole survey.

Changes in gear, protocols or estimation

During the 2016 survey:

- The tickler chain was fitted with a weak link that broke regularly. It was replaced with a G13 connector (not-so-weak link) at the end of the first leg.

Before the 2017 survey:

- The tickler chain was shortened so it is now well ahead of the footrope (approx. 3m) last year it was about 1.5-2m ahead of the footrope)
- The doors were modified by fitting a new top-end in order to increase their surface area from 5.25m^2 to approx. 5.45m^2 resulting in an additional 6% spreading power (estimated by supplier). This resulted in 4-5m extra door spread.
- The head rope was replaced and the floats were tidied up (tied on tighter and more regularly spaced). This resulted in an additional 60cm headline height, on average.
- The netting at the tips of the wings was replaced with stronger netting to avoid damage when it is pulled onto the drum on top of the floats
- This was the first year a CTD was mounted on one of the trawl doors.

During the 2017 survey:

- The codend was replaced after the area 7 part of the survey was completed (legs 1 and 2) but before the 6a part of the survey took place.

Before the 2018 survey:

- 1.2m length of chain added to the headline bridles. This chain was part of the design of the gear but was omitted from the gear plans. Fitting the chains resulted in an increase in the headline height of round 75cm and an increase in door spread of around 5m compared to 2017. There were no indications that fitting the chains changed the bottom contact or the amount of digging-in of the ground gear.

Results

Cruise narrative

A total of 116 valid tows were completed (out of a target of 115), as well as 4 additional tows to examine the effect of additional 1.2m chains in headline bridle. There were 9 invalid hauls and one haul with extensive damage on leg 4 in Donegal Bay on 10th April 2018. The weather was very good for most of the survey.

Date	Comments
Mon 19/02/2018	Mobilised in Galway
Tue 20/02/2018	Departed 07:00 hrs Completed two test tows, Marport sensors were not working, changed to 2nd master that worked but had high door spread (57.9m), switched to Scanmar but door spread still high (55.6m). These tows were not counted or input into FSS. Moved to deeper waters back of Aran island, completed two more test tows, first with chain and second without (Hauls 1 and 2, respectively). Weather good. Completed 1 valid one hour tow (Haul 3) using Marport sensors with switched out master sensor and chains.
Wed 21/02/2018	5 valid and 1 invalid tow (Haul 8). Haul 8 was on low confidence tow. Gear came fast so hauled back after 10mins but no damage was done. Moved that tow to known IGFS tow, FG99. Weather good.
Thu 22/02/2018	6 valid tows, one deep water one >600m
Fri 23/02/2018	Poor weather (30+kts wind and 4m swell) in morning caused slower transit speed between stations. CTD taken off but no data on board (batteries dead). Tried fishing stn53 but gear would not settle on ground. Hauled up and shot a few times – tried that for an hour. 3 valid hauls.
Sat 24/02/2018	Hauled for half an hour on stn15 as the bottom was hard and uneven. 5 valid hauls
Sun 25/02/2018	Some static gear in the area. 6 valid hauls completed
Mon 26/02/2018	3 valid hauls completed
Tuesday 27/02/2018	Scientific crew change for Leg 2 & sailed from Cobh 16:00, fished Stn 106 at 19:43.
Wednesday 28/02/2018	Weather moderate to good and fished 5 valid hauls up to 20:30. Master hove to for 30min prior to shooting due to consistent 45-50Kt winds and strong snow/sleet. Storm Emma due in next few hours so decision made to shelter in Dunmanus Bay, 36nmi away, for c.36hrs.
Thursday 01/03/2018	Holed up in Dunmanus Bay waiting for weather to improve. Est. to clear Friday evening.
Friday 02/03/2018	Underway again 08:00, moving out of Dunmanus Bay to site 36. Stations 36, 90 and 65 successfully fished before 00:00. Plan of remaining stations reformulated in light of lost time.
Saturday 03/03/2018	Weather good. Stations fished: - 19 @ 05:27am - 23 @ 10:34am Some long-line tangled around net A lot of mackerel caught ~2t - 61 @ 13:33 Whale (pilot?) carcass caught in net. Dead prior to catch. - Had to abandon Stn 53 after 4min due very heavy marks. Several tons of mackerel still encountered. Moved 7 nmi NW to repeat tow.
Sunday 04/03/2018	5 valid hauls, mostly deep water working around Porcupine Bight from east to west and southern Porcupine. A lot of deep water shark (with pups) and grenadiers during the day. Hydraulics leak on main drum just before midnight, repaired and running again before next tow.
Monday 05/03/2018	First tow struggling with warp ratio, very extended time to settle. Of the day: 2nd & 3rd tows shallower and settled okay with a little time. 4th tow came fast after ~42 minutes and hauled back in. No damage to net or gear. 5th okay – poss. Running along slope.

	6th tow okay.
Tuesday 06/03/2018	00:33 tow abandoned after 10 minutes. Gear sticking 04:28 again gear sticking, lifted @ 5 minutes and re-dropped, but sticking again. Abandoned ~ 20 minutes. Decision made to move on, north to station 35. On station *circa* 9am., waiting on wind to calm. 11:35 –waiting on wind to calm. 14:15 –Vessel heave averaging 3m, wind and swell dropped, moving back to start of line. 15:03 – shooting again.
Wednesday 07/03/2018	On the Porcupine in 7c. Weather fine and making good progress. Hauls all good: 63, 64, 65, 66 (ended @ 42 minutes – large mark of fish), 67, All with good sets of hake, mackerel, monk, blue whiting, few megrim. Solid day, 7 stations in 24hrs
Thursday 08/03/2018	Steady day working towards the east. Good weather. Two grab sample for AMS collected on haul No. 73 (prime station 57) and haul No. 74 (prime station 78).
Friday 09/03/2018	Into Galway harbour 9:00am. End of survey leg 2.
Tuesday 10/04/2018	Start of last leg (West of Scotland). Departed Killybegs 18:30. Good weather; very little swell. First haul at 20:30 UTC. Bad damage, returned to port to mend the gear.
Wednesday 11/04/2018	No access to berth until 08:00. Net stretched on pier and 2½ sheets replaced. Departed KBG at 16:00. First haul at 20:10 UTC. Two valid hauls completed
Thursday 12/04/2018	First haul at 05:26UTC. Mostly large volumes of catch (Spurdogs/Black Scabbard/Mackerel). Lost one catch because cod-end was not tied properly; repeated that haul. Completed 5 valid hauls.
Friday 13/04/2018	First haul at 03:14 UTC. Completed 8 valid hauls. Weather still very good.
Saturday 14/04/2018	First haul at 04:13 UTC. Completed 6 valid hauls. Wind increasing but conditions still very good.
Sunday 15/04/2018	6 valid tows completed. Conditions still good but wind and swell increasing somewhat. Trawl door fell over twice in soft ground. Did not affect wing spread.
Monday 16/04/2018	6 valid tows completed. Wind is strong SE but working in an area that is sheltered from the swell.
Tuesday 17/04/2018	5 valid tows completed. Wind still strong but swell is ok
Wednesday 18/04/2018	6 valid tows completed.
Thursday 19/04/2018	4 valid tows completed. Swell has died down a lot. Collected 3 grab samples for AMS and 3 CTDs along the Erris transect
Friday 20/04/2018	Completed last valid haul. Steamed to Aran grounds for experimental tows to determine if the 1.2m bridle extensions resulted in a change in footrope spread: the wing sensors were attached to the salvage, close to the ends of the footrope and two 10min tows were done to the west of Inis More: one with and one without the bridle extensions. The tows were done in the same direction in the same location. The tide on the first tow was across the tow at 0.1kn; for the second tow the tide was 0.2kn in the direction of the tow. The headline was 1.2m higher with the extensions in place but the door spread was 1.2m lower with the extensions. This was unexpected as the average door spread has increased by 4-5m since the extensions were fitted (at all depths except the very shallow tows). The spread of the footrope was 23.6m with the extensions and 24.2 without the extensions. The spread of the footrope was respectively 30.1% and 30.4% of the door spread. The wing spread would have been in the order of 28m. No clear conclusion on the effect of the bridle extensions.
Saturday 21/04/2018	Demob in Galway.

Downtime, damage

Weather downtime	**Thursday 1st March 2018**
Technical downtime	None
Weather downtime	Lost ½ day 23/02/2018 Lost 1 day 01/03/2018
Gear damage	First station on leg 4 in Donegal Bay on Tuesday 10/04/2018: Bad damage returned to Killybegs to repair. Net stretched on pier and 2½ sheets replaced (6 hours work). Lost 20hrs.

Summary statistics

Table 1. Summary statistics by stratum. Stratum area is given in Km^2, Num hauls is the is the number of valid hauls in each stratum and Swept area is the total area swept between the doors in each stratum (in Km^2), catch numbers (Catch Num) are given for L. piscatorius (MON), L. budegassa (WAF), L. whiffiagonis (MEG) and *Lepidorhombus whiffiagonis* (LBI).

Stratum	Stratum Area	Num Hauls	Swept Area	Catch NumMon	Catch NumWaf	Catch NumMeg	Catch NumLbi
VIa_Shelf_L	37,003	18	7.93	103	29	99	0
VIa_Shelf_M	4,746	9	4.79	117	62	62	0
VIa_Slope_H	3,114	11	6.50	356	130	329	17
VIa_Slope_M	3,044	11	6.88	419	2	307	4
VII_Porc_L	11,798	3	1.42	15	1	45	77
VII_Shelf_H	50,764	16	8.22	59	184	299	55
VII_Shelf_L	22,322	7	3.22	27	36	50	0
VII_Shelf_M	14,621	6	2.80	30	47	39	0
VII_Slope_H	35,768	24	13.52	346	196	353	185
VII_Slope_L	7,914	1	0.47	1	0	0	0
VII_Slope_M	29,406	10	6.22	100	0	5	15

Biomass estimates

Estimated numbers and biomass for the survey area are given in Table 2. Note that it is likely that the selectivity correction does not account for all the fish encountered by the gear; therefore these estimates should not be treated as absolute.

Table 2. Estimated numbers (millions) and biomass (kT) in the survey area, with CV (relative standard error) and 95% confidence intervals (low:CiLo and high:CiHi). *Only fish >500g live weight (approximately 32cm) were included in the estimate.*

	VIa MON	VII MON	VIa WAF	VII WAF
NumMln	4.569	9.289	1.137	16.846
NumCV	15.251	9.197	24.765	19.732
NumCilo	3.203	7.614	0.585	10.331
NumCiHi	5.934	10.963	1.688	23.361
BiomKT	4.887	25.519	0.868	8.198
BiomCV	12.333	9.166	23.332	19.035
BiomCilo	3.706	20.934	0.471	5.140
BiomCIHi	6.069	30.103	1.264	11.257

Gear and fishing details

Figure 2 gives details of fishing net geometry of valid tows: distance towed, depth / warp length, warp length / door spread and door spread / wing spread. These show expected distributions and ranges.

Catch

The length-weight relationship for *L. piscatorius* and *L. budegessa* caught over the course of the survey followed expected relationships (Figure 3). Figures 4 and 5 summarise the catch distribution across the survey area, and by areas (VIa (6a) and VII (7)) of *L. piscatorius* and *L. budegessa* respectively. *L. piscatorius* tended to show higher densities in the VIa Slope and VIa High strata, and lower densities in the VII Shelf High and VIa Shelf Low strata. *L. budegessa* showed highest densities on VII Shelf High and VIa Slope High, and lowest on VIa Slope Medium and VII Porcupine Low and were absent on VII Slope Low and VII Slope Medium strata.

Figure 6 shows that the relative influence each of the fishing tows had on the final density estimate was generally equitable (i.e there was no single tow that had a disproportionally large influence on the estimates), especially for *L. piscatorius* in VII, while for the both areas and *L. budegassa*, a few tows were somewhat influential to the total biomass estimate and in terms of the percentage relative standard error (RSE).

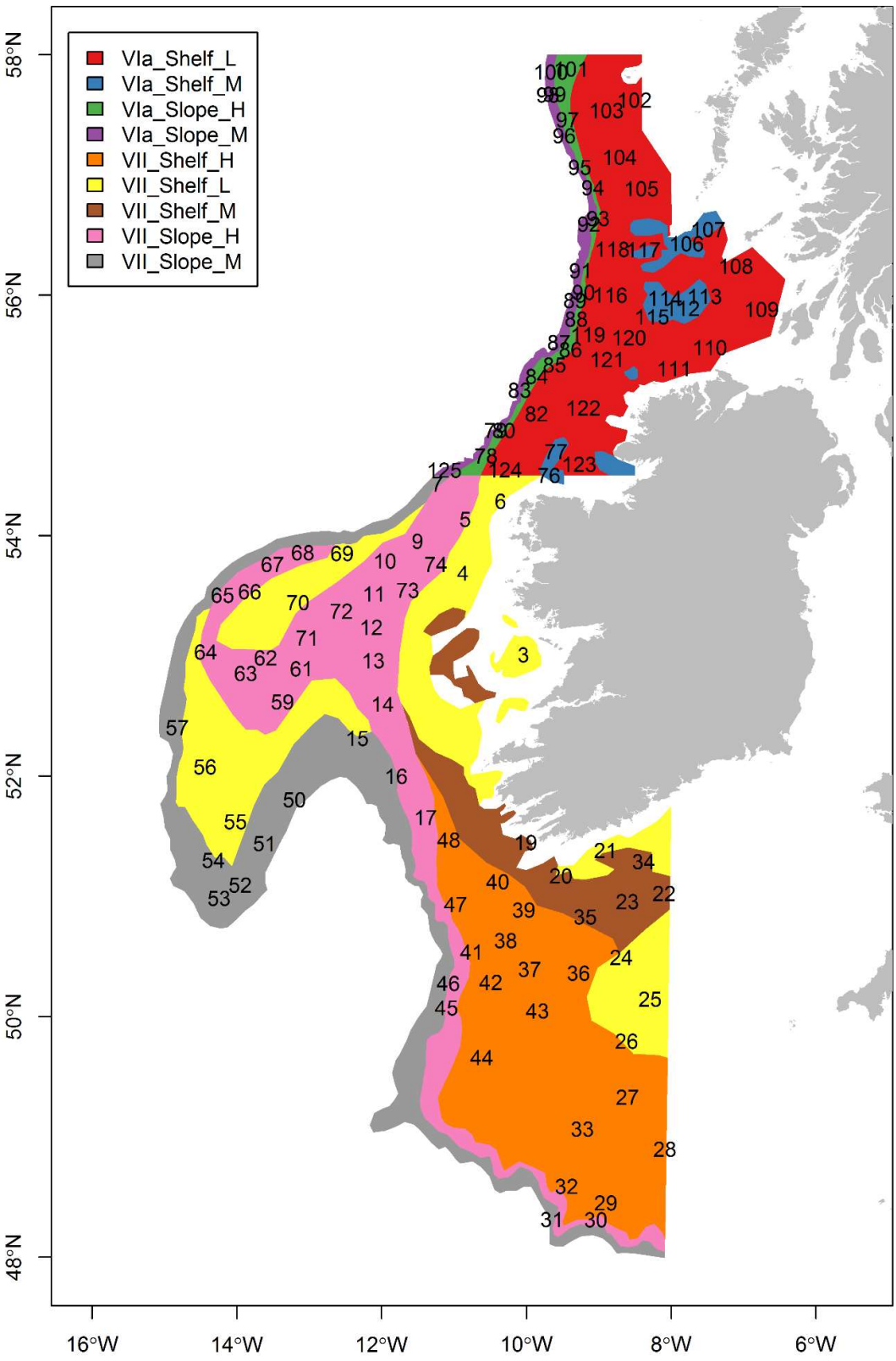

Figure 1. Valid tow positions, the numbers refer to the haul number.

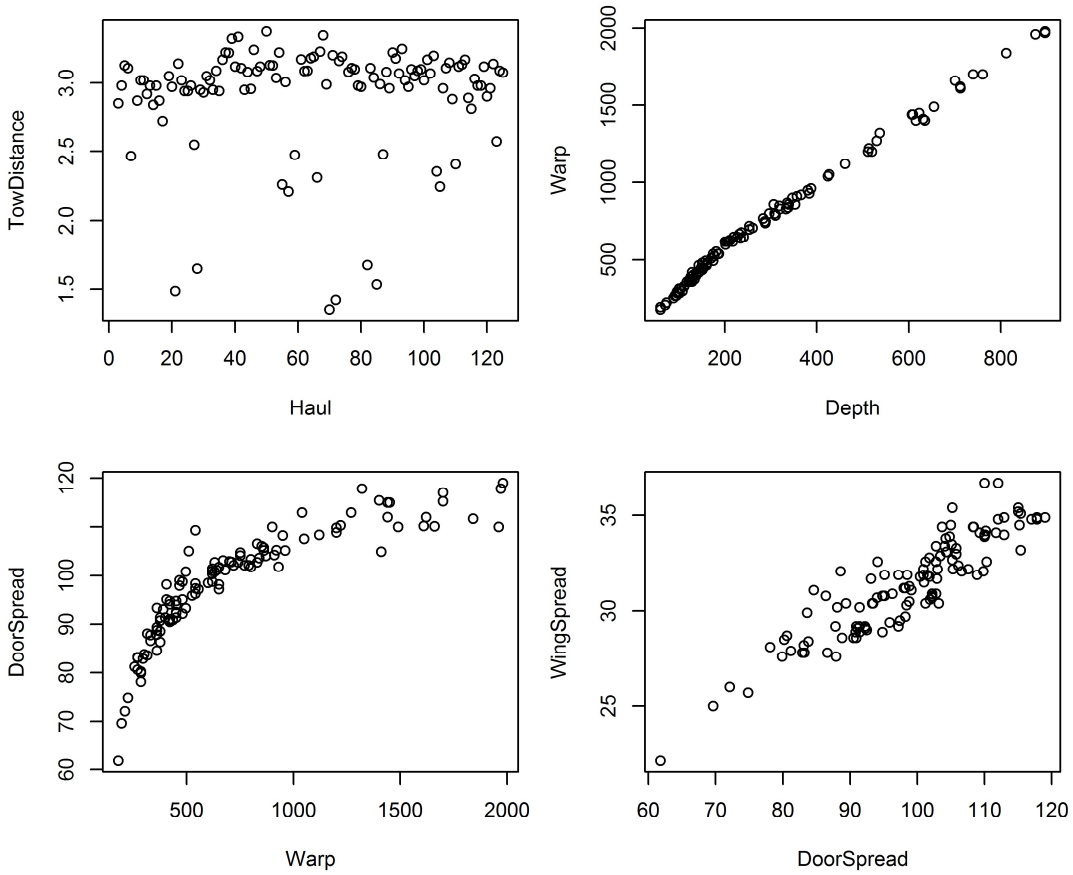

Figure 2. Gear parameters for the valid hauls

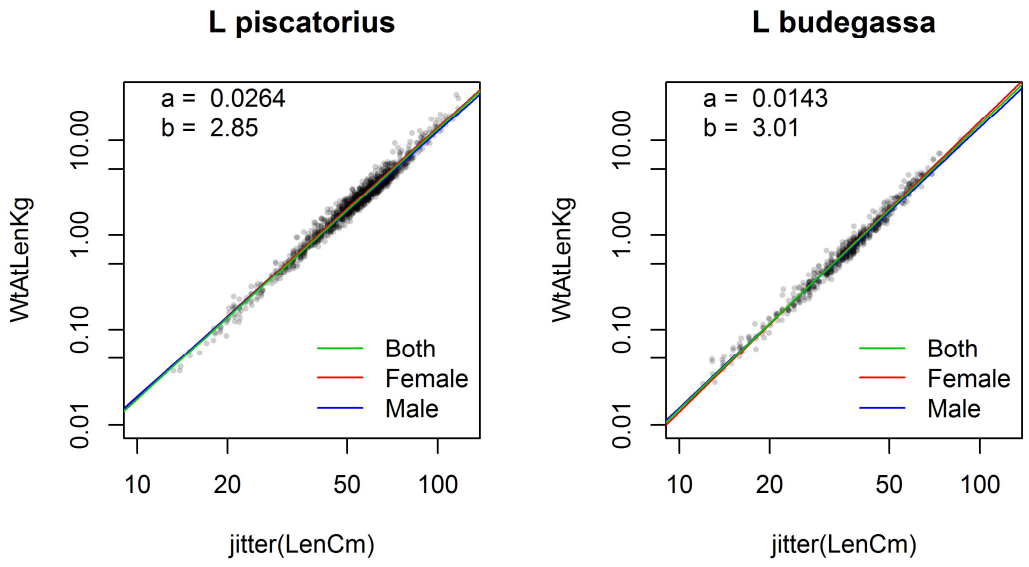

Figure 3. Length-weight parameters

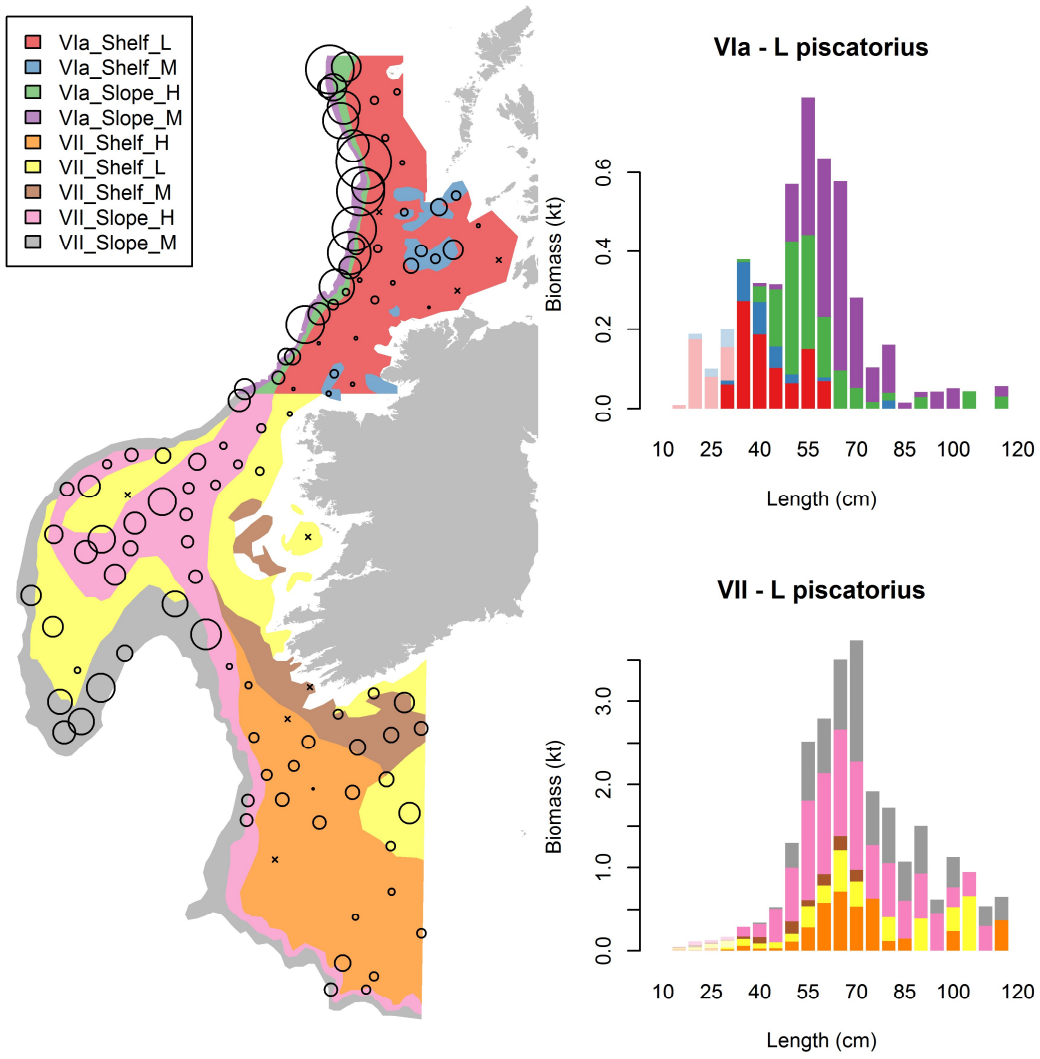

Figure 4. Bubble size is proportional to the biomass of L. piscatorius *per swept area at each sampling station (left; >500g fish only) and biomass per size class and stratum (right; fish <500g in pale shades).*

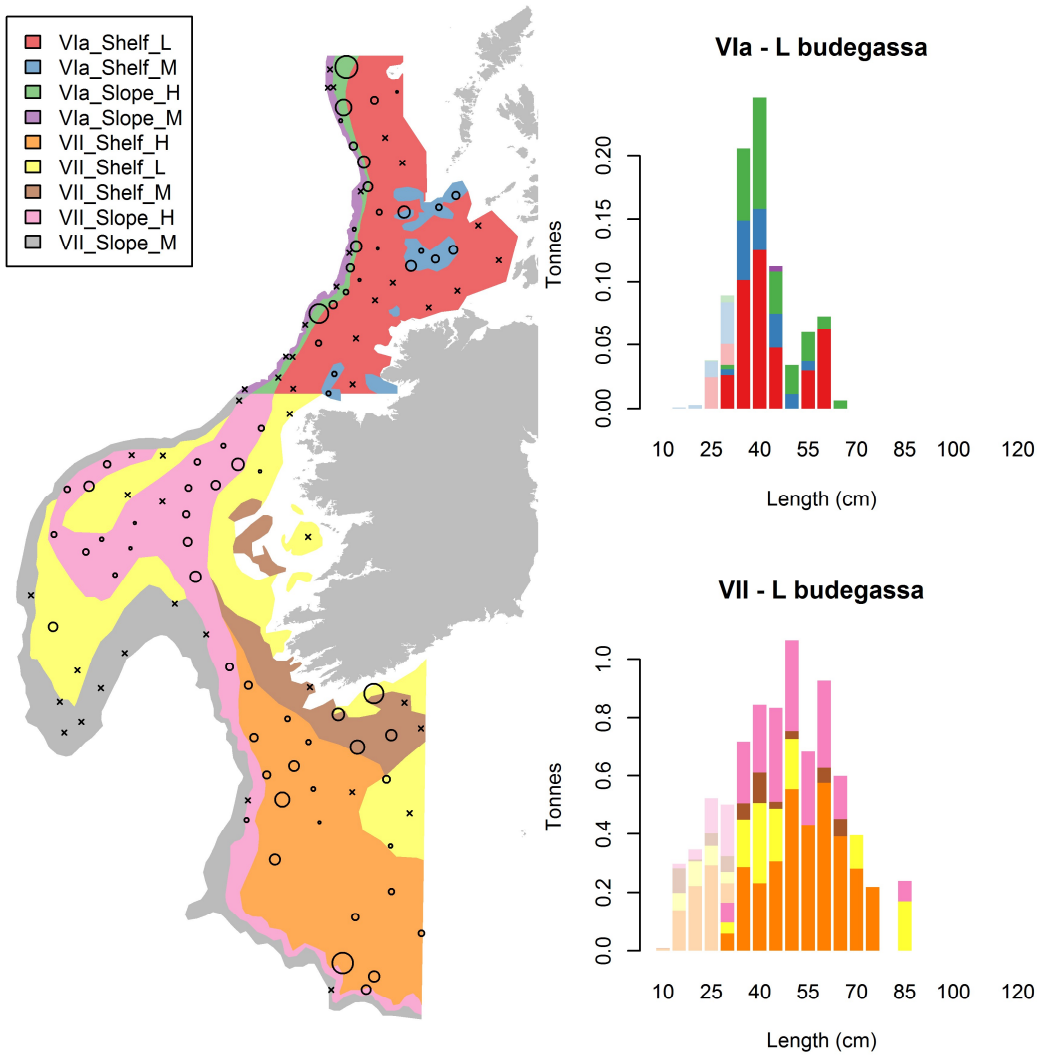

Figure 5. Bubble size is proportional to the biomass of L. budegassa *per swept area at each sampling station (left; >500g fish only) and biomass per size class and stratum (right; fish <500g in pale shades).*

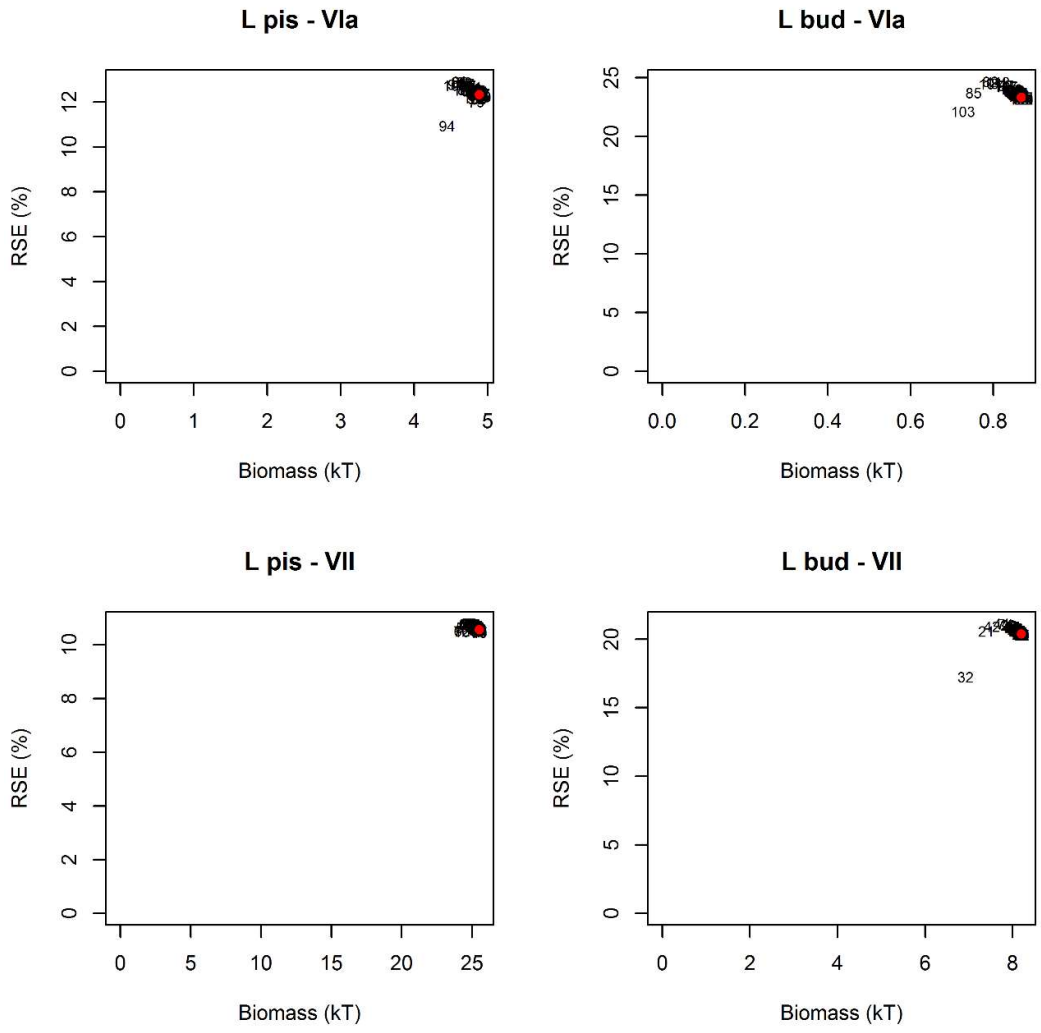

Figure 6. Influence that each tow had on the final biomass estimate. Estimates were obtained by sequentially removing each of the tows from the analysis. The red dot indicates the final estimate (with all the valid tows included). For L. piscatorius in 6a station 94 was most influential (i.e. without this station the biomass estimate and the RSE would have been considerably lower); for L. budegassa in 6a, stations 103 and 85 were most influential. For L. piscatorius in 7, none of the stations had a disproportionate influence and for L. budegassa in 7, station 32 was most influential.

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Appendix 1: List of survey staff

Name	Organisation	Role
Aidan Long	NUIG	Wetlab Scientist
Annaclare McCarthy	Marine Institute	Wetlab Scientist
Artur Opanowski	Survey Contractor	Wetlab Scientist
Bartley Hernon	P&O	Master Fisherman
Cristina Otero	GMIT	Wetlab Scientist
Dave Stokes	Marine Institute	Scientist In Charge
Dave Tully	Marine Institute	Wetlab Deckmaster
Dermot Fee	Marine Institute	Wetlab Deckmaster
Eoghan Kelly	Marine Institute	Scientist In Charge
Felim O'Toole	NUIG	Wetlab Scientist
Frankie McDaid	Survey Contractor	Wetlab Scientist
Gabriel Serrano	GMIT	Wetlab Scientist
Gráinne Ryan	Marine Institute	Wetlab Deckmaster
Grant Course	Survey Contractor	Wetlab Scientist
Hans Gerritsen	Marine Institute	Scientist In Charge
Ivan Daly	Unaffiliated	Wetlab Scientist
John Enright	Marine Institute	Wetlab Scientist
John Power	Survey Contractor	Wetlab Scientist
Jonathan White	Marine Institute	Scientist In Charge
Karl Bentley	Survey Contractor	Wetlab Scientist
Kieran Byrne	Unaffiliated	Wetlab Scientist
Leigh Barnwall	NUIG	Wetlab Scientist
Michael Kinneen	NUIG	Wetlab Scientist
Mikel Aristegui Ezquibela	GMIT	Wetlab Scientist
Paul Bouch	Marine Institute	Wetlab Scientist
Paul Whitelaw	UCC	Wetlab Scientist
Robert Bunn	Marine Institute	Wetlab Deckmaster
Sara-Jane Moore	Marine Institute	Scientist In Charge
Sean McLaughlin	Marine Institute	Wetlab Scientist
Sean O'Connor	Marine Institute	Wetlab Deckmaster
Sharon Sugrue	Marine Institute	Wetlab Scientist
Sinéad O'Brien	Marine Institute	Wetlab Scientist
Stephanie Linehan	Unaffiliated	Wetlab Scientist
Stephen Brennan	Survey Contractor	Wetlab Scientist
Tobi Rapp	Marine Institute	Wetlab Deckmaster

Appendix 2: Additional Sampling

Request	Details	Requested by	Target	Number collected
Nephrops Sampling	Nemesis catch sampling	Jennifer Doyle (MI)	All	All
Litter	Litter log per tow	OSPAR	All	All
CTD on trawl door	Download data	DCF (MI)	All	All
CTD transects	Big CTD – if time allows	Kieran Lyons (MI)	One per leg if possible	0 (no time)
Genetics Mon	96 fish from 7	AZTI	96	96
Genetics Mon	24 fish from 6	AZTI	24	24
MON otoliths	All MON from 7gjk	Hans Gerritsen (MI)	All	All
Grab samples	Sub sample from Day grab	Fabio Sacchetti (MI)	NA	2
Dogfish (LSD)	Freeze 60 fish all sizes	Graham Johnson (MI)	60	60
Antimora rostrata	Freeze with haul number	Graham Johnson (MI)	30	0 (not encountered)
Deepwater spp	Freeze some unusual species	Joe Cooney (MI)	NA	1 box
Elasmobranch Tagging	Tag & record elasmobranchs	Macdara O'Cuaig (MI)	NA	23
Genetics WAF/MON	Green boxes in fridge	Edward Farrell (UCD)	50 WAF; 50 MON	50 WAF; 50 MON
Seafest weird fish	Bag and tag weird fish	Gráinne Ní Chonchuir (MI)	6 large bags	6 large bags

Appendix 3: Summary of station location, gear geometry and catch

Note: Valid station only

Haul	Stratum	LonDeg W	LatDeg N	Depth mtr	Dist nm	Door mtr	Wing mtr	Mon Num	Waf Num	Mon Kg	Waf Kg	Mon $KgKm^{-2}$	Waf $KgKm^{-2}$	Mon Tons	Waf Tons
3	VII_Shelf_L	-10.042	53.010	108	2.8	83.8	28.4	3	4	0.6	0.5	0.0	0.0	36	48
4	VII_Shelf_L	-10.875	53.691	154	3.0	91.4	28.9	8	5	5.7	1.7	3.3	0.5	181	72
5	VII_Slope_H	-10.848	54.136	218	3.1	98.8	30.5	12	14	14.6	8.2	4.1	1.8	145	108
6	VII_Shelf_L	-10.359	54.290	129	3.1	91.1	29.1	2	0	1.9	0.0	1.1	0.0	58	0
7	VII_Slope_M	-11.232	54.430	514	2.5	110.3	32.6	12	0	33.4	0.0	22.1	0.0	650	0
9	VII_Slope_H	-11.504	53.956	311	2.9	102.2	30.9	9	4	9.2	4.3	2.5	1.1	108	46
10	VII_Slope_H	-11.955	53.791	333	3.0	102.8	30.9	15	4	57.4	8.1	13.9	1.9	497	73
11	VII_Slope_H	-12.107	53.519	320	3.0	106.6	32.1	15	5	25.1	7.8	6.0	2.1	237	75
12	VII_Slope_H	-12.145	53.241	284	2.9	102.2	30.8	12	10	26.1	8.0	7.1	2.2	255	94
13	VII_Slope_H	-12.119	52.962	254	2.7	102.2	30.7	8	12	33.1	11.5	7.4	3.9	264	146
14	VII_Slope_H	-11.988	52.602	237	2.8	101.2	30.4	14	15	32.0	21.5	9.0	6.0	321	223
15	VII_Slope_M	-12.341	52.317	635	3.0	115.4	33.2	13	0	53.6	0.0	29.8	0.0	878	0
16	VII_Slope_M	-11.802	52.001	520	2.9	109.8	32.1	21	0	73.8	0.0	42.2	0.0	1242	0
17	VII_Slope_H	-11.397	51.659	232	2.7	103.2	30.4	6	15	6.5	14.5	1.7	2.7	65	162
19	VII_Shelf_M	-10.012	51.450	73	3.0	74.8	25.7	3	0	0.2	0.0	0.0	0.0	16	0
20	VII_Shelf_M	-9.523	51.172	112	3.0	86.6	27.8	9	20	4.4	8.1	4.3	6.9	117	198
21	VII_Shelf_L	-8.907	51.384	97	1.5	82.9	27.8	3	15	4.7	12.5	5.5	17.3	267	789
22	VII_Shelf_M	-8.096	51.028	104	3.2	83.6	29.9	2	1	8.2	0.4	8.2	0.0	120	10
23	VII_Shelf_M	-8.606	50.958	112	3.0	87.8	29.2	5	14	9.2	5.2	10.3	5.6	151	129
24	VII_Shelf_L	-8.690	50.496	124	2.9	91.4	29.2	2	4	16.8	4.7	10.1	2.7	424	136
25	VII_Shelf_L	-8.291	50.146	138	2.9	98.2	31.2	8	2	37.3	0.3	20.6	0.0	878	19
26	VII_Shelf_L	-8.617	49.798	129	3.0	88.8	28.6	1	6	7.1	1.8	4.1	0.9	171	85

27	VII_Shelf_H	-8.605	49.332	144	2.7	90.9	29.2	1	2	4.8	3.4	2.2	1.6	111	90
28	VII_Shelf_H	-8.089	48.898	152	1.7	92.5	29	1	3	4.9	2.0	4.1	1.8	208	100
29	VII_Shelf_H	-8.903	48.452	175	2.9	98.4	30.3	2	8	11.4	17.1	3.9	5.6	198	297
30	VII_Slope_H	-9.040	48.312	220	2.9	98.2	29.7	3	13	16.6	18.0	3.9	4.4	138	186
31	VII_Slope_M	-9.646	48.313	427	3.0	107.6	32.2	3	0	14.3	0.0	8.1	0.0	239	0
32	VII_Shelf_H	-9.446	48.589	178	3.0	95.9	29.4	10	49	34.2	66.1	12.0	20.3	660	1281
33	VII_Shelf_H	-9.229	49.066	159	2.9	93.3	30.4	1	3	4.5	7.0	1.9	2.4	96	134
34	VII_Shelf_M	-8.379	51.291	97	3.1	78.1	28.1	7	4	15.7	0.3	17.8	0.0	260	17
35	VII_Shelf_M	-9.188	50.830	125	2.9	87.9	27.6	4	8	12.0	9.0	11.7	9.6	171	157
36	VII_Shelf_H	-9.281	50.363	123	3.2	84.6	31.1	3	0	30.4	0.0	9.1	0.0	463	0
37	VII_Shelf_H	-9.955	50.395	134	3.3	86.4	30.8	1	2	0.6	2.5	0.3	0.9	14	51
38	VII_Shelf_H	-10.286	50.633	152	3.2	92.3	29.1	5	7	20.8	14.1	5.4	5.1	273	258
39	VII_Shelf_H	-10.038	50.887	128	3.4	90.8	28.9	7	2	20.7	2.7	7.8	1.2	402	60
40	VII_Shelf_H	-10.395	51.124	149	3.1	94.8	28.9	0	8	0.0	3.7	0.0	1.4	0	108
41	VII_Shelf_H	-10.756	50.540	186	3.3	97.4	29.5	5	10	20.2	9.7	5.5	2.9	281	192
42	VII_Shelf_H	-10.491	50.287	153	3.1	92.2	29.2	7	33	30.6	30.1	8.4	9.9	426	670
43	VII_Shelf_H	-9.846	50.048	144	2.9	90.5	28.6	6	4	19.1	1.5	8.2	0.4	415	53
44	VII_Shelf_H	-10.613	49.661	151	3.1	90.9	28.6	2	29	0.1	15.8	0.0	5.4	12	452
45	VII_Slope_H	-11.105	50.074	384	3.0	101.9	30.6	6	10	28.8	7.8	7.5	1.1	268	90
46	VII_Slope_H	-11.081	50.279	511	3.3	108.9	31.9	6	0	35.7	0.0	7.1	0.0	256	0
47	VII_Shelf_H	-10.978	50.935	181	3.0	97.2	29.2	6	12	12.0	9.4	4.5	3.0	236	227
48	VII_Shelf_H	-11.071	51.470	187	3.2	96.3	30.9	2	12	7.8	8.5	2.2	2.7	113	206
50	VII_Slope_M	-13.206	51.805	896	3.4	119	34.9	5	0	28.4	0.0	11.7	0.0	345	0
51	VII_Slope_M	-13.616	51.441	740	3.2	117	34.8	9	0	90.5	0.0	36.8	0.0	1081	0
52	VII_Slope_M	-13.956	51.096	616	3.2	115.4	35.1	11	0	65.6	0.0	30.3	0.0	890	0
53	VII_Slope_M	-14.249	50.986	761	3.0	115.2	34.5	8	0	47.6	0.0	24.0	0.0	706	0
54	VII_Slope_M	-14.326	51.300	531	3.2	112.9	34	10	0	56.8	0.0	27.5	0.0	808	0
55	VII_Shelf_L	-14.022	51.623	424	2.3	112.9	34.9	1	0	2.7	0.0	1.9	0.0	79	0
56	VII_Shelf_L	-14.442	52.078	353	3.0	105.2	35.4	6	1	43.2	8.7	19.3	4.1	811	170

57	VII_Slope_M	-14.824	52.403	607	2.2	115	35.2	8	0	28.6	0.0	18.5	0.0	545	0
59	VII_Slope_H	-13.371	52.619	347	2.5	110	33.9	15	1	71.6	3.7	21.1	1.0	755	36
61	VII_Slope_H	-13.106	52.894	381	3.1	108.3	34.4	16	1	48.4	2.9	10.6	0.6	390	20
62	VII_Slope_H	-13.603	52.986	205	3.0	100.4	31.8	48	2	156.9	3.5	35.8	0.9	1300	31
63	VII_Slope_H	-13.878	52.857	200	3.1	101.5	31.9	38	5	123.1	8.6	24.5	2.0	889	73
64	VII_Slope_H	-14.429	53.034	297	3.2	103.4	32.9	24	3	73.3	7.7	15.4	1.6	572	57
65	VII_Slope_H	-14.198	53.506	357	3.2	104.3	33.1	14	3	43.5	10.6	9.0	1.8	326	65
66	VII_Slope_H	-13.821	53.537	261	2.3	102.9	31.7	14	7	74.6	15.5	23.7	5.1	846	182
67	VII_Slope_H	-13.509	53.763	319	3.2	106.1	32.4	9	2	19.1	12.2	3.8	2.5	144	90
68	VII_Slope_H	-13.088	53.860	366	3.3	105.3	32.2	13	0	36.1	0.0	8.6	0.0	309	0
69	VII_Shelf_L	-12.549	53.855	388	2.9	105.2	32.7	9	0	22.7	0.0	11.2	0.0	484	0
70	VII_Shelf_L	-13.156	53.446	210	1.3	100.9	31.9	0	0	0.0	0.0	0.0	0.0	0	0
71	VII_Slope_H	-13.030	53.153	309	3.2	101.8	32.8	18	1	101.0	2.1	22.6	0.4	807	15
72	VII_Slope_H	-12.557	53.374	336	1.4	104.1	33.4	15	0	71.8	0.0	35.8	0.0	1279	0
73	VII_Slope_H	-11.640	53.547	227	3.2	101.8	31.8	7	17	18.5	14.9	NA	NA	NA	NA
74	VII_Slope_H	-11.253	53.764	208	3.2	101	31.5	9	52	13.1	32.9	3.6	7.3	130	382
76	VIa_Shelf_M	-9.690	54.503	99	3.1	79.9	27.6	10	2	3.7	1.6	5.7	4.7	104	32
77	VIa_Shelf_M	-9.589	54.702	101	3.1	80.2	28.5	12	2	5.7	2.3	15.1	5.6	136	36
78	VIa_Slope_H	-10.557	54.665	287	3.1	104.8	33.9	6	0	15.6	0.0	14.4	0.0	45	0
79	VIa_Slope_M	-10.423	54.879	812	3.1	111.7	34.1	7	0	24.7	0.0	25.3	0.0	77	0
80	VIa_Slope_H	-10.312	54.877	338	3.0	103.7	34.4	4	0	29.3	0.0	20.9	0.0	65	0
82	VIa_Shelf_L	-9.861	55.016	126	1.7	88.6	32.1	1	2	0.5	3.5	4.4	15.3	162	676
83	VIa_Slope_M	-10.092	55.213	712	3.2	112	36.7	36	0	168.4	0.0	143.3	0.0	436	0
84	VIa_Slope_H	-9.854	55.327	241	3.0	97.2	31.9	22	26	41.6	28.6	41.4	31.5	129	100
85	VIa_Shelf_L	-9.611	55.423	202	1.5	98.5	31.9	3	5	7.5	3.7	46.5	28.6	1720	1060
86	VIa_Slope_H	-9.390	55.549	212	3.0	102.8	33.4	2	5	4.9	2.8	4.3	2.6	13	12
87	VIa_Slope_M	-9.551	55.608	655	2.6	110	34	0	0	0.0	0.0	0.0	0.0	0	0
88	VIa_Slope_H	-9.313	55.803	289	3.1	104.2	33.8	0	0	0.0	0.0	0.0	0.0	0	0
89	VIa_Slope_M	-9.331	55.958	712	3.0	110.2	34.2	0	0	0.0	0.0	0.0	0.0	0	0

90	VIa_Slope_H	-9.209	56.027	234	3.4	101.2	32.6	0	0	0.0	0.0	0.0	0.0	0	0
91	VIa_Slope_M	-9.250	56.206	701	3.2	110.1	34	0	0	0.0	0.0	0.0	0.0	0	0